REMARKS

In the last Office Action, claims 4 and 6 were objected to as being in improper dependent form. Claim 1 was rejected under 35 U.S.C. §102 as being anticipated by U.S. Patent Nos. 6,078,738 to Garza, 6,562,638 to Balasinski et al. ("Balasinski"), and 5,530,372 to Lee et al. ("Lee"). The Examiner stated that each of the foregoing references discloses a pattern evaluation method comprising the steps of storing CAD data for an IC device formed on a wafer, reading the CAD data for a predetermined pattern of the IC device, and superimposing the CAD data with an electron microscope image of the pattern formed on the wafer.

Claims 2-4 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,493,867 to Mei et al. ("Mei") in view of Balasinski. The Examiner stated that Mei discloses a method comprising the steps of storing CAD data of an IC device formed on a wafer, scanning a first pattern formed on the wafer, comparing the CAD data of the first pattern against the scanned wafer, and comparing a second pattern which is formed at a later step against an image of the scanned wafer. The Examiner pointed out that while Mei does not disclose that the comparing step is performed by overlapping the first and second CAD images with the electron microscope image, Balasinski discloses

overlapping CAD images with electron microscope images. In view of this disclosure, the Examiner has taken the position that it would have been obvious to incorporate the teachings of Balasinski into the teachings of Mei because linking of CAD data and aerial images facilitates navigation around the chip.

Claims 5 and 6 were rejected under 35 U.S.C. §103(a) as being unpatentable over Mei in view of Balasinski, and further in view of Lee. Lee was cited as disclosing a navigation apparatus comprising means for providing a low magnification microscope image by controlling a stage based on position information, means for calculating a deviation amount using CAD line segment and performing a matching process on the low magnification microscope image in order to obtain a pattern image of a predetermined portion at a center of the field of vision using a microscope having a high magnification.

By the present response, the specification has been suitably revised to correct informalities, improve the wording, provide an antecedent basis for newly-added new claim language, and to update the cross-reference to the parent application. Claims 1-6 have been canceled without prejudice or admission and replaced by new claims 7-16. The newly added claims comprise revised versions of the original claims rewritten in formal respects to improve the wording and place

them in better conformance with U.S. practice, and to more particularly point out and distinctly claim the novel aspects of the present invention. The newly added claims also contain additional claims added to provide a fuller and more comprehensive scope of coverage. Adequate support for the subject matter recited in these claims may be found in the specification as originally filed.

Applicant respectfully submits that claims 7-16 patentably distinguish over the prior art of record.

In semiconductor fabrication, a plurality of patterns to be formed on a semiconductor are stored as CAD data. Photomasks are fabricated using the CAD data, and a large number of semiconductor devices are simultaneously fabricated side-by-side on a semiconductor wafer. Therefore, the photomasks are provided with a plurality of identical patterns for each of the devices to be fabricated on the wafer. Invariably, warpage of the wafer and the photomask, and aberrations in the optical system cause circuit patterns to vary somewhat across a wafer. This can be alleviated somewhat by designing patterns with a sufficient margin of error to compensate for anticipated optical aberrations and warpage. However, downsizing of device dimensions makes this difficult to do.

The present invention provides an apparatus for evaluating whether deviations between successively formed patterns of a semiconductor device fall in an allowable design range, and which enable a determination of whether a positional relationship between an already formed pattern and a successively formed pattern that has not yet been formed is within a desired range. Thus, the present invention enables changes to be made in subsequent fabrication steps to compensate for detected deviations in patterns that have not yet been formed.

More specifically, as recited by newly added independent claim 7, and with reference to the embodiment shown in Fig. 4, the inventive apparatus 1 for evaluating a deviation between successively formed patterns comprises a memory 12 for storing CAD data used to form the successively formed patterns of the semiconductor device, a microscope 13 for obtaining an image of an already formed one of the patterns on the semiconductor wafer, and a monitor 3 for displaying the image obtained with the microscope 13. The apparatus further comprises means (e.g., CAD apparatus 11) for reading first CAD data D2 used to form the already formed pattern of the semiconductor device, displaying the first CAD data D2 with the displayed image of the already formed pattern as a first overlapped image on the monitor 3 to enable

evaluation of the already formed pattern, reading second CAD data D3 to be used to form a successive pattern of the semiconductor device that will be connected to the already formed pattern, and displaying the second CAD data D3 with the displayed image of the already formed pattern and the first CAD data D2 as a second image on the monitor 3 to enable evaluation of the successively formed pattern.

Accordingly, the present invention provides an apparatus for evaluating deviations between patterns of a semiconductor device based on CAD data by displaying an overlapped image comprised of an optical image of a pattern of the semiconductor device obtained using a microscope and a CAD image used to fabricate the viewed pattern. This enables an evaluation of the acceptability of the formed pattern to be made. Enhanced evaluation is enabled by overlapping a CAD image of a pattern to be formed in a later step along with the optical image of the already formed pattern and the CAD image thereof.

In order to align the respective images, a wafer pattern observing apparatus having a CAD navigation function is used, the apparatus being provided with the capability of displaying the overlapped image comprised of the optical microscope image of a predetermined pattern and the CAD images.

By enabling a defect to be detected at an early stage, failures can be avoided by modifying a process used to form the successive pattern.

No corresponding apparatus is disclosed or suggested by the prior art of record.

New independent claim 7 requires means for displaying a microscope image of a predetermined pattern overlapped with a CAD image of the predetermined pattern, and overlapping thereon a second CAD image of a pattern to be connected to the predetermined pattern. None of the cited references discloses a similar apparatus. Accordingly, none of the cited references are believed to anticipate any of newly added claims 7-15.

Neither Mei, Balasinski or Lee, taken alone or in combination, would have suggested the subject matter recited by newly added independent claim 7.

Mei was cited as disclosing a digital photolithography system including means for storing CAD data of an IC device formed on an IC wafer, scanning a first pattern formed on an IC wafer, comparing the CAD data of first pattern against the scanned wafer, and comparing a second pattern against the scanned wafer. However, applicant cannot determine where Mei discloses means for comparing the CAD data of first pattern or second pattern against an image of a scanned wafer.

In Mei, a computer provides a digital pattern to a digital pixel panel, such as a deformable mirror device (DMD). The DMD provides a plurality of pixel elements for exposure onto a plurality of wafer sites. However, Mei does not disclose that an optical image of a first pattern formed on a wafer based on CAD data and an image produced using the CAD data are compared, or overlapped. Nor does Mei disclose or suggest an apparatus for comparing or overlapping a CAD image of first and second patterns with an electron microscope image of the first pattern formed based on the CAD data as the Examiner contends.

Although Balasinski discloses means for overlapping a CAD image with an electron microscope image, Balasinski does not disclose additional means for overlapping an electron microscope image of a first pattern with a CAD image of a second pattern which is to be connected to the first pattern, as required by newly added independent claim 7.

Lee fails to disclose or suggest an apparatus for calculating a deviation amount between a low magnification microscope image of a predetermined pattern and a CAD line segment corresponding to the low magnification microscope image of the predetermined pattern by a matching process in order to obtain an image of the predetermined pattern at a center of a field of view by the microscope.

Accordingly, the cited references would not have fairly suggested to the ordinarily skilled artisan the concept of overlapping an SEM image of an already formed pattern with a first CAD image of the already formed pattern and a second CAD image of a pattern than will later be formed to partly overlap the predetermined pattern.

Thus, applicant respectfully submits that newly added claim 7 and dependent claims 8-15 patentably distinguish over the prior art of record.

Applicant further submits that the subject matter of newly added independent claim 16 patentably distinguishes over the prior art of record. Claim 16 recites a CAD navigation apparatus having means for designating a predetermined pattern of a device, an imaging apparatus for displaying an image of the predetermined pattern, means for acquiring low magnification pattern image data of the predetermined pattern by controlling an observation position of the imaging apparatus so that a center of observation of the predetermined pattern falls in a predetermined field of view, sampling means for outputting edge line segment data by sampling an edge of the predetermined pattern contained in the low magnification pattern image data, means for obtaining CAD line segment data of the predetermined pattern corresponding to the low magnification pattern image data, means for calculating a

deviation amount between the center of observation of the imaging apparatus and a center of the predetermined field of view by comparing the CAD line segment data and the edge line segment data, and means for controlling a position of a sample stage of the imaging apparatus such that the center of observation and the center of the predetermined field of view coincide with each other.

The cited references fail to disclose or suggest the structure recited by newly added independent claim 16.

Accordingly, applicant respectfully submits that claims 7-16 patentably distinguish over the prior art of record.

In view of the foregoing amendments and discussion, the application is now believed to be in condition for allowance. Accordingly, favorable reconsideration and allowance of the claims are most respectfully requested.

Respectfully submitted,

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SEPTEMBER 6, 2006
Date